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Enabling Interdisciplinary Analysis

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New requirements for evaluating environmental conditions in the Pacific Northwest have led to increased demands for interdisciplinary analysis of complex environmental problems. Procedures for watershed analysis have been developed for use on public and private lands in Washington State (Washington Forest Practices Board 1993) and for federal lands in the Pacific Northwest (REO 1995). In both cases, analyses are intended to provide integrated, interdisciplinary evaluations of the biological, physical, and socio-economic interactions that influence the ecoscape and to describe environmental changes and their causes. "Interdisciplinary" implies that expertise from multiple disciplines is providing an integrated attack on a problem area. "Interdisciplinary" is carefully distinguished from "multi-disciplinary," which implies only that multiple inquiries are being carried out at the same time or in the same place.

Those developing the federal and state procedures called for integrated interdisciplinary evaluations for several reasons. First, environmental problems are inherently interdisciplinary. It is not possible to evaluate the reasons for a change in flood frequencies in an area, for example, without understanding the changes in land-use activities in the area, the processes that generate storm flow, the changes in channel morphology that have occurred, and the effects of vegetation change on both hydrology and geomorphology. One discipline, acting alone, would be equipped to evaluate only one aspect of the many that are likely to have influenced flooding. The influences that a single discipline would most likely overlook are indirect effects that involve the interaction of several components of the ecoscape. These influences appear to be subtle because they have fallen through the cracks between disciplines in the past. But as the least well understood, these influences are in most need of evaluation.

In addition, much disciplinocentric information already exists for many areas, yet the relevance of the information has not been recognized either because people have not had the time or inclination to look at the data or because the wrong people have examined it. Interdisciplinary work makes the undiscovered treasures of one field accessible to others who can recognize their value. In one case, for example, differences between a soils map and a vegetation map were thought to be errors until anthropological information revealed that the discrepancies recorded a profound change in vegetation type following the cessation of burning by Native Americans.

Interdisciplinary work is also needed to ensure that the overall focus of the project is maintained. Mono-disciplinary analyses filter the objectives through the biases of a single field. Interdisciplinary work helps ensure that the effort is apportioned according to the relevance of different types of information for addressing the overall needs, and not simply on the basis of how things are done in a particular field. An interdisciplinary evaluation continually challenges participants to show the relevance of their own pursuits to the overall objectives of the project.

Evaluation of the complex environmental problems dealt with during watershed analysis requires each specialist to have an appreciation for, interest in, and understanding of the other specialties represented in the effort. A major challenge for analysis teams is thus to find ways to promote interdisciplinary teamwork. Observations of federal watershed analysis teams, interviews with team members, and review of analysis documents indicate that this challenge is not yet being met effectively.

Barriers to Interdisciplinary Cooperation

One of the most severe hurdles for such analyses is the difficulty that individuals find in working together in an interdisciplinary framework. Many "teams" are teams in name only; individuals have done "their" parts of the analysis independently and have left the integration to an editor or have entirely ignored integration, electing instead to present the report as a series of stand-alone monodisciplinary chapters. In other cases, published analyses read as data compendia. Few of the reports provide the balanced, interdisciplinary perspective intended by the guiding directives. The reasons for the difficulty in achieving true interdisciplinary analysis are many and span the range between societal expectations and individuals' personalities.

At a societal scale, the philosophy of western science extols the value of increasingly detailed understanding within increasingly specialized sub-disciplines, while demeaning the value of the "generalist." Western science views the world largely as mechanistic: take a complicated thing apart and understand in detail how all the components work, then put them back together and you will understand the whole. This strategy for problem-solving permeates western education; the focus is on detail and precision rather than on meaning. Just as a standard grammarian cannot tell you the meaning of the sentence "He's bad," a standard biologist cannot tell you the meaning of a local decrease in salmon populations. But both can parse their respective sentences and find professional fulfillment in the parsing. Reverence for specialization works in a direction opposite to that needed for cross-disciplinary communication and understanding.

Federal watershed analysis teams are made up primarily of personnel of participating federal agencies, people who carry scars inflicted by past battles over funding and policy. Diminishing agency budgets have produced competition between disciplines for limited funding, and a budget increase for one subject area often represents a cutback in others. Feelings of collegiality between disciplines are difficult to maintain in such circumstances, and one discipline would be unlikely to push for cooperation with and thus funding of another discipline, even if the other discipline could help them reach their own goals. As a result, we find peculiarities such as the propensity for agency fisheries biologists to do their own geomorphological evaluations of stream channels using methods that geomorphologists know to be wrong. In addition, different disciplines historically have had different goals within agencies, and many professionals see their own roles as being advocates for their area of interest. Some agency wildlife biologists have become known as "combat biologists" whose perceived role is to champion the interests of particular species by fighting off the impacts of agency misdeeds; their constituency becomes a species, rather than the agency or the public.

The drive to specialize also is present at a professional level, and the most respected professionals often are those that have carved out the smallest niches. In addition, every field has complementary needs for affiliation, marketing, and communication, and historically, the development of specialized jargons has contributed to meeting all three needs. If you speak your own language, you are a definable group; your job appears sophisticated and the uninitiated cannot presume to do it; and you can communicate with your peers more efficiently. The advantages of jargon become deficits when a

team is working in an interdisciplinary setting; here, the vocabulary must be restricted to words that everyone can understand. Some professionals find this difficult because, in the words of one interdisciplinary team member, "Other geologists won't take me seriously if I don't speak their language." In addition, analytical methods are best developed within the context of a particular discipline, so working at an interdisciplinary interface often means abandoning the established methods. For example, if it is necessary to characterize a few stream channels for an analysis, an interdisciplinary team cannot use the cookbook techniques established by fisheries biologists, geomorphologists, or hydrologists. Instead, an ad-hoc method must be developed that will fill the specific needs of the interdisciplinary question being asked.

Some of the most difficult barriers to overcome are those that arise from the personalities of participants. Working in an interdisciplinary environment quickly reveals how much individuals don't know about the other disciplines, and high-level professionals often are uncomfortable working in an arena in which they appear ignorant. In addition, individuals believe in the importance and relevance of their own field, and it is humbling to work with people who do not necessarily share one's assumptions of one's own importance. Another problem is the natural propensity to prescribe a solution on the basis of the solutions one understands rather than on the basis of what the problem requires. In the words of one observer of problem-solving efforts, "If the only tool you have is a hammer, the whole world looks like a nail."

Making Interdisciplinarity Work

One approach to developing an effective interdisciplinary team is to hand-pick people who are likely to make it work. By understanding the nature of the barriers to interdisciplinary work, it becomes possible to define the personal characteristics and skills needed of interdisciplinary team participants.

Team members must each have a broad-enough view of the overall problem to be able to think beyond the boundaries of their own disciplines. In many cases, the most specialized professionals are least able to see the broader context of the problems. People who have broad backgrounds, such as might be provided by undergraduate degrees in fields such as geography, those with double majors or a broad work experience, and those with "hobby" interests in other fields, are particularly well equipped to see the bridges between fields rather than the fences. Usually allayed with a broad interest is a strong curiosity about how the world works. Someone known for attending seminars or conferences outside their own field or for conversing with other disciplinary groups is likely to be a useful team member.

All participants must have the ability to translate their own field's jargon into language the other team members can understand, and to understand that the same word may have very different connotations and value loads in different fields. In biological and physical sciences, for example, "evolution" is a value-neutral synonym for a trend through time, while in social sciences it represents a theory of social development with strong imperialistic overtones and thus carries a decidedly negative connotation. Each member must be able to recognize the quirks and complexities of their own field and to explain them to a broader audience, and for this, some practical experience in teaching is likely to be useful.

Some individuals have the self confidence needed to wade into the unknown and ask dumb questions. People with the strongest needs to protect their own egos are the least useful on interdisciplinary teams, since the teamwork requires each individual to develop a realistic view of their overall relevance to the problems and to expose their own ignorance by asking the simple questions needed to

develop a working understanding of the other fields. Each participant must be able to take on the dual role of expert in their own field and, at first, naive tyro in everyone else's. Any naive tyros who do not expose their ignorance by asking questions are doomed to remain naive tyros.

Self confidence is also needed to allow participants the freedom of abandoning established methods when those methods are not relevant to the problems being addressed. Individuals must have enough expertise in their fields to be able to design methods that peculiarly suit the particular problems they face. In many cases, no suitable methods have been developed. At the same time, individuals must have the humility needed to recognize when their own methods and approaches are inferior to those suggested by others. The traits of self confidence and humility are closely linked: often it is self-confidence that allows humility to be expressed.

A second overall approach to facilitating interdisciplinary analysis is to design the analysis strategy to force interdisciplinary cooperation. In the context of watershed analysis, this might be accomplished by insisting that the report be focused around issues (e.g. flooding) or environmental changes (e.g. vegetation conversion). Each focal area then inherently demands an integrated interdisciplinary evaluation. Also useful might be to provide an example of what a desirable interdisciplinary product looks like. At this point, few good examples exist, so it is not surprising that few teams have a good image of what an interdisciplinary analysis is.

Another overall approach is to provide mechanisms and opportunities to enhance interdisciplinary cooperation. The experiences of federal watershed analysis teams have revealed several techniques that aid in forging interdisciplinary teams.

First, the issue of interdisciplinarity must be discussed so that all team members understand the difference between multi-disciplinarity and inter-disciplinarity. Related to this is the fundamental need for the entire team to develop a shared vision for the task. All participants must at the outset develop a common image of what the product will look like, its scope, and the role it is expected to fulfill.

Second, exercises in "selling" others on the relevance of one's own discipline to the various facets of the overall problem help to develop one's own awareness of the linkages between one's discipline and others. Reciprocally, the exercise provides an opportunity for others to learn of information that may help solve problems in their areas of specialty. If the interdisciplinary team is embarking on a long-term program, it may be useful to schedule an on-going seminar series in which each team member introduces the others to the major ideas in their fields. Such an exercise helps each "teacher" develop a facility for translating their jargon and gives each "student" information needed to translate jargon that does slip through, or even to adopt jargon that is generally applicable.

Third, a field day can be scheduled during which each specialist describes to others what she or he is seeing and inferring at each of a few diverse sites. Such an exercise often discloses fundamental differences in how different disciplines perceive and interpret aspects of the ecoscape. During one such exercise, geomorphologists and biologists realized that they had been talking about two very different parts of the stream system when they had discussed "first-order channels," and this difference could only have been discovered in the field. In other cases, disciplines are introduced to other interpretations of and explanations for environmental changes relevant to their own fields.

Fourth, specialists from several fields can be assigned the task of working together to produce a flow-chart diagram of the interactions that affect a particular issue or that arise from a particular environmental change. This exercise develops a facility for cross-communication as well as provides

an analysis tool. Such "mind map" diagrams can become the basis for interdisciplinary analyses by providing a framework for identifying the strongest interactions and for recognizing the most useful information to gather. Such a task was assigned during an interdisciplinary graduate seminar, and student reactions indicated that the same characteristics that made the exercise frustrating were the ones that made it valuable. Students from different fields had very different ways of viewing the problems and found that it took a lot of discussion and argument before they could understand others' points of view. Once understood, however, those points of view deepened their understanding of the problem.

Finally, and perhaps most painfully, the analysis document can be rigorously edited to excise any information that has not been demonstrated to be relevant to the focus of the analysis. Such an approach encourages analysts to test their words continually against the criterion of relevance and to focus their efforts on tasks that lead toward the overall objectives.

Interdisciplinary work is often difficult and frustrating, but the results have value beyond that represented by the report produced. As specialists broaden their understanding of the ecoscape as a whole, they become better equipped to solve problems even within their own fields. But effective interdisciplinary work doesn't just happen; it requires appropriate people, appropriate assignments, and appropriate management.

References

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